SCIENTIFIC LETTER

Population based study on the prevalence of the stages of heart failure

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Heart 2006;**92**:1161–1163. doi: 10.1136/hrt.2005.072629

Heart failure (HF) is a major health issue. The heterogeneous nature of the syndrome impairs agreement on a standard definition. The high prevalence of HF with preserved left ventricular (LV) systolic function and asymptomatic LV systolic dysfunction, and the need for objective evidence of cardiac structural or functional abnormalities for HF diagnosis increase the difficulty in achieving a consensual definition. We aimed at estimating the age and sex specific prevalence of the American College of Cardiology (ACC)/American Heart Association (AHA)[1] stages of HF in a representative sample of non-institutionalised adults from Porto, Portugal.

METHODS

Within a population health survey (participation 70%),[2] we measured the prevalence of HF among participants aged $\geqslant$ 45 years.[2] The local ethics committee approved the study. Participants provided written informed consent.

Hypertension was defined as blood pressure $\geqslant$ 140/90 mm Hg or treatment with medication, and diabetes mellitus was defined as self reported or fasting blood glucose $\geqslant$ 7 mmol/l. The metabolic syndrome was defined according to the National Cholesterol Education Program-Adult Treatment Panel III, obesity as body mass index $\geqslant$ 30 kg/m^2, and excessive alcohol intake as $>$ 100 or $>$ 80 g/day in men and women, respectively. Coronary artery disease was defined as self reported diagnosis of angina or myocardial infarction or pathological Q waves on ECG. Chronic lung disease was defined as previous chronic bronchitis or moderate to severe obstruction (forced expiratory volume in one second $<$ 70% of predicted) or restriction (vital capacity $<$ 70% of predicted) on spirometry. One investigator (CAL) reviewed echocardiograms. LV systolic dysfunction was defined by an ejection fraction $<$ 45% or by visual estimate. LV hypertrophy was defined as LV mass index $>$ 110 g/m^2 in women and 125 g/m^2 in men and LV dilatation was defined as end diastolic diameter $>$ 58 mm in men and 52 mm in women.[3] Participants were classified according to the ACC/AHA HF stages, where: A comprises hypertension, diabetes, the metabolic syndrome, coronary artery disease, smoking, excessive alcohol intake, and no structural or functional cardiac abnormalities; B comprises LV systolic dysfunction, LV dilatation, moderate to severe valve disease, and LV hypertrophy; C comprises HF symptoms or signs plus any abnormality described in stage B except LV hypertrophy, which was considered responsible for symptoms only in the absence of chronic lung disease; and D comprises advanced structural heart disease and symptoms despite maximum treatment.

Data are described as mean (SD) for quantitative variables and counts (proportions) for categorical variables. Prevalences were compared by the χ^2 test. Quantitative variables were compared between men and women by Student's *t* test.

RESULTS

The sample consisted of 296 men and 443 women with mean (SD) age of 63 (11) and 61 (10) years, respectively. Table 1 shows the prevalence of cardiovascular risk factors, coronary artery disease, and chronic lung disease. Symptoms listed in table 1 were more common in women. Men had significantly lower mean ejection fraction and higher LV mass index. Women had significantly larger LV end diastolic diameter and left atrial diameter (indexed to body surface area).

No participant was in stage D. As table 2 shows, overall 7.2% (95% confidence interval (CI) 5.4 to 9.3) were in stage C. Stage C prevalence was higher among women due to the large contribution of LV hypertrophy and dilatation. It increased with age in both sexes (p for trend 0.002 and $p < 0.001$ in men and women). Asymptomatic cardiac structural or functional abnormalities were observed in 21.4% (95% CI 18.5 to 24.5). The prevalence of HF stage B was similar in men and women and increased with age more clearly and strongly in women. The prevalence of symptomatic or asymptomatic cardiac structural or functional abnormalities (stages B and C) increased significantly with age among both men ($p = 0.007$) and women ($p < 0.001$). On the basis of risk factor assessment, 48.0% (95% CI 44.4 to 51.7) were at high risk for HF with the proportion being higher in men. The remaining 23.4% (95% CI 20.4 to 26.6) could be classified as having low HF risk. Low risk was more common in younger women.

DISCUSSION

To the best of our knowledge, this is the first population based reporting of the ACC/AHA stages of HF. The prevalence of stage C in this sample was higher than the prevalence of symptomatic HF described in previous studies, both in Europe and the USA. Differences between our estimate of HF prevalence and those of previous national and international reports reflect differences in the definition of HF and in the age distribution of the study participants. The ACC/AHA guidelines for the classification and diagnosis of HF use a wider concept of HF such that patients with LV hypertrophy, a structural cardiac abnormality, and clinical symptoms and signs compatible with HF are grouped in stage C.[1]

Several clinical criteria, sometimes with a score of findings, have been defined for the clinical diagnosis of HF. Most scores include data from a chest radiograph, which was not obtained in our study. To increase the specificity of our evaluation of the symptoms and signs of HF, we decided to use the approach of the Rotterdam study whereby only the presence of at least two symptoms or signs was considered sufficient for stage C classification.[4]

We identified no stage D participant. This was expected because such patients would have much difficulty attending the interview due to the severity of the disease, and our sample size provided little power for this objective. However, HF or a compatible set of complaints was never offered as the reason for refusal. Furthermore, these patients are more

Abbreviations: ACC, American College of Cardiology; AHA, American Heart Association; CI, confidence interval; HF, heart failure; LV, left ventricular

Table 1 Demographic and clinical data of the study sample

	Men (n = 296)	Women (n = 443)	p Value
Medical history and risk factors			
Hypertension	189 (63.9%)	261 (58.9%)	0.20
Diabetes mellitus	31 (10.5%)	36 (8.1%)	0.34
Obesity	47 (15.9%)	143 (32.5%)	<0.001
Metabolic syndrome*	41 (14.9%)	102 (23.8%)	0.005
Coronary artery disease	33 (11.1%)	38 (8.6%)	0.30
Current smoking	71 (24.3%)	43 (10.2%)	<0.001
Chronic lung disease	53 (17.9%)	57 (12.9%)	0.08
Symptoms			
Dyspnoea			<0.001
No	213 (72.0%)	260 (58.8%)	
Walking uphill or >2 staircases	36 (12.2%)	68 (15.4%)	
Walking uphill or ⩽2 staircases	31 (10.5%)	54 (12.2%)	
Walking on ground level or at rest	16 (5.4%)	60 (13.6%)	
Orthopnoea	5 (1.7%)	16 (3.6%)	0.19
Nocturnal paroxysmal dyspnoea	6 (2.0%)	28 (6.3%)	0.01
Ankle oedema at the end of the day	36 (12.2%)	149 (33.6%)	<0.001
Ankle oedema at the end of the day and no chronic venous insufficiency	27 (9.1%)	112 (25.3%)	<0.001
Physical examination			
Systolic blood pressure (mm Hg)	138 (19)	137 (20)	0.38
Diastolic blood pressure (mm Hg)	82 (11)	81 (10)	0.25
Heart rate (beats/min)	76 (12)	74 (11)	0.11
Body mass index (kg/m^2)	26.9 (3.7)	28.7 (4.8)	<0.001
Jugular venous distension	18 (6.1%)	30 (6.8%)	0.81
Pulmonary rales	28 (9.5%)	36 (8.2%)	0.62
Third heart sound	1 (0.3%)	2 (0.5%)	0.81
Medications			
ACEI	50 (17.1%)	73 (16.8%)	0.92
ARB	10 (3.4%)	14 (3.2%)	0.89
β Blocker	20 (6.8%)	23 (5.3%)	0.49
Calcium channel blocker	28 (9.6%)	38 (8.8%)	0.82
Diuretic	40 (13.7%)	73 (16.8%)	0.30
Digoxin	5 (1.7%)	9 (2.1%)	0.94
Statin	37 (12.6%)	67 (15.4%)	0.33
Diuretic + (ACEI or ARB)	17 (5.8%)	35 (8.0%)	0.31
Diuretic + (ACEI or ARB) + β blocker	2 (0.7%)	2 (0.5%)	0.70
Diuretic + (ACEI or ARB) + digoxin	2 (0.7%)	2 (0.5%)	0.70
Diuretic + β blocker	4 (1.4%)	6 (1.4%)	0.98
Atrial fibrillation on ECG	3 (1.0%)	5 (1.1%)	0.89
Echocardiogram			
LV ejection fraction (%)	58.7 (7.7)	60.2 (7.0)	0.01
LVEDD (mm)	48.8 (5.2)	46.5 (4.1)	<0.001
LVEDD/BSA (mm/m^2)	26.4 (2.9)	28.0 (3.0)	<0.001
LA (mm)	37.4 (4.8)	35.9 (4.4)	<0.001
LA/BSA (mm/m^2)	20.2 (2.5)	21.6 (3.0)	<0.001
LV mass index (g/m^2)	107 (34)	99 (28)	0.001

Data are number (%) for categorical variables and mean (SD) for continuous variables.
*n = 699 (424 women and 275 men) due to missing data on analytical or anthropometric variables for 40 participants.
ACEI, angiotensin converting enzyme inhibitor; ARB, angiotensin II receptor blocker; BSA, body surface area; LA, left atrial diameter; LV, left ventricular; LVEDD, left ventricular end diastolic diameter.

Table 2 Prevalence (95% confidence intervals) of the American College of Cardiology/American Heart Association stages of heart failure according to age, by sex

	45–64 years	⩾65 years	Total
Men	n = 164	n = 132	n = 296
Low risk	25.0% (18.6 to 32.3)	11.4% (6.5 to 18.0)	18.9% (14.6 to 23.8)
Stage A	54.9% (46.9 to 62.6)	53.8% (44.9 to 62.5)	54.4% (48.5 to 60.2)
Stage B	18.9% (13.2 to 25.7)	25.0% (17.9 to 33.3)	21.6% (17.1 to 26.8)
Stage C	1.2% (0.1 to 4.3)	9.8% (5.3 to 16.2)	5.1% (2.9 to 8.2)
Women	n = 281	n = 162	n = 443
Low risk	34.9% (29.3 to 40.8)	11.7% (9.2 to 17.7)	26.4% (22.4 to 30.8)
Stage A	45.9% (40.0 to 51.9)	40.1% (32.5 to 48.1)	43.8% (39.1 to 48.6)
Stage B	14.9% (11.0 to 20.0)	32.1% (25.0 to 39.9)	21.2% (17.5 to 25.3)
Stage C	4.3% (2.2 to 7.3)	16.0% (10.8 to 22.6)	8.6% (6.1 to 11.6)

likely to be institutionalised and are often admitted to hospital, factors contributing to a lower likelihood of being identified in our study.

In the absence of previous specific reports on these stages the high prevalence of asymptomatic cardiac abnormalities and of patients at high risk for HF was surprising.

There are therapeutic options with documented benefit in delaying or even preventing progression to symptomatic HF. Yusuf and Pitt[5] called attention to the relatively modest research aimed at preventing HF in high risk patients in comparison with the extensive efforts aimed at discovering new treatments for patients after HF develops. The results of our study are useful in this regard. They may be helpful in quantifying the magnitude of the HF problem in the population by dissecting stages and their progression by age.

ACKNOWLEDGEMENTS

This study was supported by a grant from Fundação para a Ciência e a Tecnologia of the Portuguese Ministério da Ciência e Tecnologia (POCTI 35769/99).

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Competing interests: none declared

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Accepted 7 November 2005

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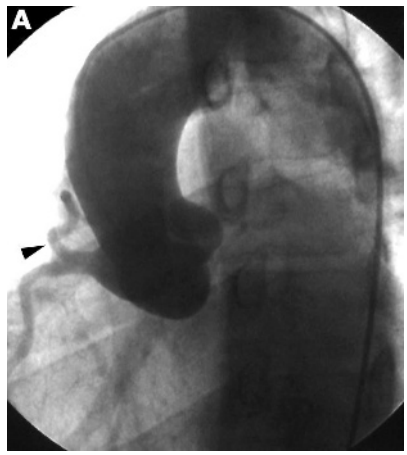
IMAGES IN CARDIOLOGY

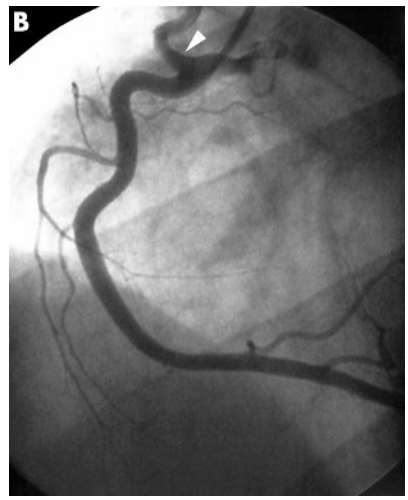
doi: 10.1136/hrt.2005.080424

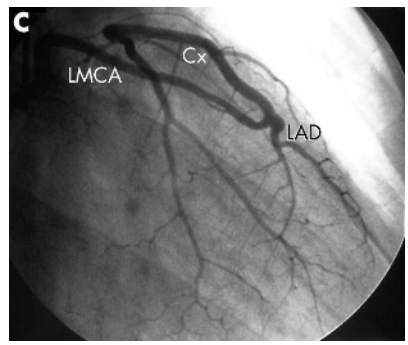
A rare and potentially lethal coronary artery anomaly

A 42-year-old man was admitted with central chest pain which he described as "someone sitting on his chest". He had a strong family history of premature coronary artery disease and raised cholesterol. He completed over nine minutes of a treadmill stress test, complaining of chest tightness and breathlessness after seven minutes but with no ECG changes.

Coronary angiography demonstrated an anomalous origin of the left main coronary artery (LMCA) arising from the right sinus of Valsalva (panels A and B, arrow) and only mild coronary atheroma. Congenital coronary artery anomalies of this type are relatively rare. However, they can be associated with episodic ischaemia, myocardial infarction and more importantly, with sudden cardiac death particularly among young athletes, depending on the anatomical relationship with the great vessels. The potentially lethal type of this anomaly occurs when the LMCA runs an interarterial course between the aorta and pulmonary trunk and requires prompt correction. This man has a more benign variant where the LMCA runs an intramuscular course before branching into the left anterior descending artery (LAD) and circumflex artery (Cx) in the mid portion of the interventricular septum (panel C).







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